



EPA Answers Questions Most Often Asked by Residents

Lindsay Light II/RV3 North Columbus Drive Site

Chicago, Illinois

May 2000

INTRODUCTION

The purpose of this fact sheet is to provide community residents and other interested individuals with responses to questions frequently asked about the Lindsay Light II /RV3 North Columbus Drive Site cleanup.

What is Thorium?

Thorium is a metallic element. It is part of the Thorium Decay Series, which is a series of radioactively decaying elements. Both thorium and the Thorium Decay Series are found naturally.

Where did the Thorium come from?

Thorium used on this site probably came from India, Brazil, South Africa, Florida, the Carolinas and Idaho in an ore called Monazite. Monazite is found in beach and river deposits of minerals that eroded from larger deposits and washed downstream. These were mined, shipped to Chicago, and chemically purified to obtain the thorium and other elements necessary to produce gas mantles. Unused ore and chemical wastes are the site contaminants.

How was the radiation at the site discovered?

U.S. EPA had removed thorium contaminated soil from an adjacent property over several past years. When the ground was broken on the North Columbus property, U.S. EPA obtained access on the potential that it might also contain thorium contaminants. Surveys showed there was also contamination on this property.

How did U.S. EPA get involved?

U.S. EPA used its authority under the Comprehensive Environmental Response, and Compensation, Liability Act (CERCLA). CERCLA, also known as "Superfund," is a law designed to

help cleanup abandoned waste facilities. Under CERCLA, potentially responsible parties include the owner and operator of a facility, any person who at the time of the disposal owned or operated the facility. In 1996, U.S. EPA ordered companies to conduct the cleanup activities at 316 East Illinois. In March 2000, U.S. EPA amended the Order to include the North Columbus Drive site and the owner of that property.

What is U.S. EPA's cleanup level and how was it determined?

U.S. EPA relied upon a soil radium standard for uranium and thorium sites found in Part 40, Title 192 of the Code of Federal Regulations (40 CFR 192). This standard is 5 picocuries per gram (pCi/g) of total radium (radium-226 plus radium-228) over background in each 6-inch layer below ground. 5 pCi/g is 11 radioactive decays per minute per gram of soil. The background total radium level near North Columbus Drive is 2.1 pCi/g. Therefore, the clean-up level for this site is $5 + 2.1$ or 7.1 pCi/g.

What is involved in the cleanup?

Contaminated soils are first located using hand-held gamma-ray detectors. These sites are excavated with construction equipment until the gamma ray detectors indicate the cleanup criterion had been met. Soil samples are taken to confirm this. U.S. EPA is then called to perform a verification survey, which includes independently performing a gamma ray survey and taking soil samples. Each 100 square meter (about 120 square yard) area must meet the cleanup criterion of 5 pCi/g of total radium (radium-226 plus radium-228) over background (altogether 7.1 pCi/g). If the cleanup criterion is met, the area is released for unrestricted use. If the cleanup criterion is not met, excavation continues until the criterion is met.

EPA Region 5 Records Ctr.



226128

What is the nature and extent of contamination?

The primary contaminant is believed to be radioactive thorium, but uranium and radium have also been measured in these soils. All of these are believed to have been present in Monazite ore processed for thorium.

The original survey showed contamination in an area about 125 feet by 125 feet in southwest part of the site and contamination in scattered pockets throughout the rest of the site. Excavations in the eastern and southern parts of the site have shown more contamination, which is now known to extend under the sidewalks on Columbus Drive, Illinois Street, and Grand Avenue.

What is being done to remedy the situation?

Contaminated soils are being excavated, put in metal boxes on flatbed semis and shipped via railroad to the licensed disposal site in Utah. The developer and potentially responsible parties are cooperating with U.S. EPA in surveying the site, providing health and safety surveillance, and disposing of the contaminated soils.

Is the contamination contained?

Contaminated soils on site are being removed. Materials have been found at the perimeter of the site, and under sidewalks. These will be handled under surveillance agreements and removed when sidewalks, streets or utilities must be worked on. So long as they remain covered by concrete and asphalt they do not present a health and safety concern. U.S. EPA hopes to survey perimeter properties in the near future.

Some contaminated material was sent to an offsite landfill. U.S. EPA will require a site survey to determine the extent of contamination and will require a remediation plan.

The City of Chicago has agreed to restrict access to anyone exposing or working in the soils covered by the sidewalks and streets. The City will give U.S. EPA notice of anyone proposing to work there and require anyone who must expose or work in the soils beneath the sidewalks and street to implement a health and safety plan, conduct radiation surveillance and dispose of any

excavated contaminated materials.

How long do you estimate it will take to complete the remediation?

The remediation program will continue as long as necessary to remove the contamination. Originally, this was projected to take eight weeks, starting from early April. Potentially, the project may take longer, therefore, an exact estimated time frame can not given at this time.

What is the probability that adjacent lots are also contaminated?

U.S. EPA knows that there is contamination under some adjacent streets and in one nearby building. A surveillance project is contemplated for other perimeter properties to determine if additional contamination is present beyond the known sites.

What are the potential health risks to the environment?

U.S. EPA has required a health and safety plan that should allow site cleanup to proceed without danger to site workers, the general public and the environment. Potential health risks include exposure to gamma rays, inhalation of radioactive dusts, ingestion of contaminated soil, skin contamination and spreading of the contaminants beyond where they are now. Controls for these potential risks include maintaining levels As Low As Reasonably Achievable so that doses to workers are minimal and doses to the general public are kept to background levels. There must be no visible dust onsite, air concentrations to workers and at the fence of the property must be kept below regulatory levels, workers onsite must not pick up contaminated soil on their skin or clothes, and vehicles or equipment leaving the site must not contain radioactivity above regulatory levels. Other measures to control dust include the "watering down" of the site during working hours.

What, if any, are the human health hazards?

The contaminants of concern are radioactive and can raise the risk of cancer in specific organs and can raise the risk for the body as a whole. This may occur by exposure of the body to gamma rays, by ingestion and inhalation of radioactive materials, and by skin exposure to contaminants. Since

radiation exposure is a statistical risk there will not be a certainty of cancer from exposure and there will be no immediate, observable reactions..

Is there a danger to the water supply (ground and surface)?

Groundwater under the site is not used for drinking. Additionally, the thorium materials are very insoluble and past measurements have not shown groundwater contamination. To be prudent, U.S. EPA plans additional groundwater measurements on this site. No water, whether surface water or ground water, will be allowed to leave the site without meeting release standards.

Is there the threat of runoff?

U.S. EPA's oversight has not shown runoff to be an issue. If runoff was evident, U.S. EPA would require that it be contained and dealt with in a safe and healthful way.

If I walk by the site will I be in danger.

Using radiation meters, it has been determined, that gamma rays on the surrounding sidewalks are at background levels. Required air monitoring has shown that concentrations are well below regulatory levels for the general public. Fences assure that a person passing by does not get close enough to the contaminants to ingest them or get them on their skin. U.S. EPA feels that the public is well protected, but would take corrective measures, if perimeter conditions showed significant changes.

WEB SITES

This and additional updates can be found at the following web sites:

www.epa.gov/region5/sites/

Scroll down through the list to find the Lindsay Light II/RV3 North Columbus Drive site.

FOR ADDITIONAL INFORMATION

If you have questions about the information in this fact sheet or would like additional information about the Lindsay Light Sites, please contact the individuals listed below:

Derrick Kimbrough
Community Involvement Coordinator
Office of Public Affairs (P-19J)
(312) 886-9749
kimbrough.derrick@epa.gov

Verneta Simon
On-Scene Coordinator
Superfund Division (SE-5J)
(312) 886-3601
simon.verneta@epa.gov

Fred Micke
On-Scene Coordinator
Superfund Division (SE-5J)
(312) 886-5123
micke.fredrick@epa.gov

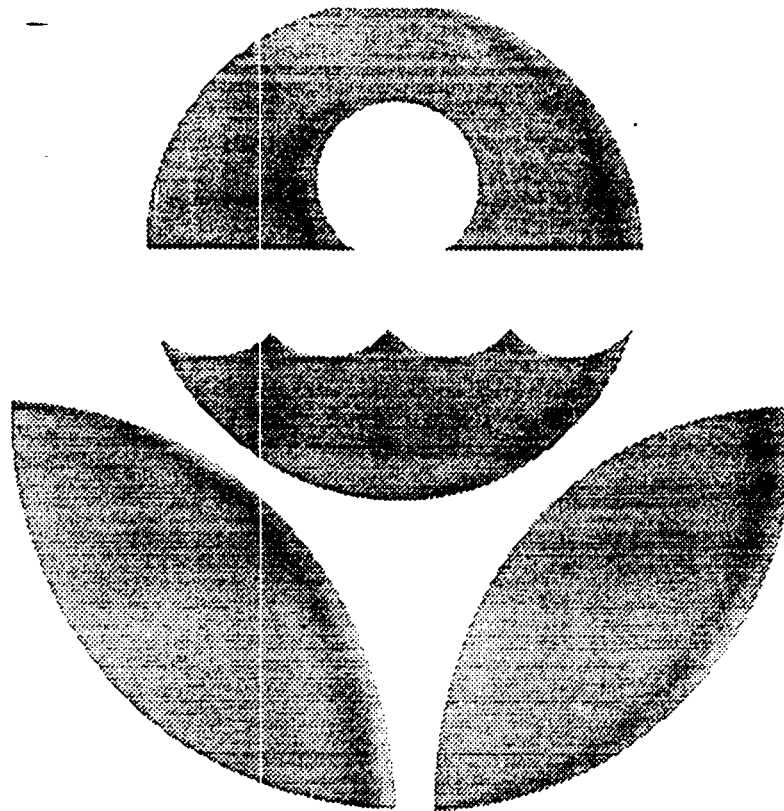
U.S. EPA Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590
(800) 621-8431

24-hour response number (312) 353-2318

Lindsay Light site-related information is available at the following location:

Harold Washington Public Library
400 South State
Chicago, Illinois

Monday: 9:00 a.m. to 7:00 p.m.
Tues. and Thurs.: 11:00 a.m. to 7:00 p.m.
Wed., Fri., and Sat.: 9:00 a.m. to 5:00 p.m.
Sunday: 1:00 p.m. to 5:00 p.m.



United States Environmental Protection Agency
Office of Public Affairs
Region 5
77 West Jackson Boulevard (P-19J)
Chicago, IL 60604-3590



Reproduced on recycled paper

Environmental Protection Agency (E.P.A.)
Office of the General Counsel

General & Administrative

*1 November 8, 1972 [FNa1]

FACTS

As a condition to entry on industrial facilities, certain firms have required EPA employees to sign agreements which purport to release the company from tort liability. The following "Visitor's Release" required by the Owens-Corning Fiberglass Corporation is an example:

VISITOR'S RELEASE

In consideration of permission to enter the premises of Owens Corning Fiberglass Corporation and being aware of the risk of injury from equipment, negligence of employees or of other visitors, and from other causes the

undersigned assumes all risk, releases said corporation, and agrees to hold it harmless from liability for any injury to him or his property while upon its premises...

READ CAREFULLY BEFORE SIGNING

In addition to such "Visitor's Releases" employees or their supervisors have been asked to sign entry permits which include an agreement that EPA will pay for any injury or damage resulting from our activities at the facility.

QUESTIONS

1. Does signing such a "Visitor's Release" effectively waive the employee's right to obtain damages for tortious injury?
2. May EPA employees contractually obligate the Agency to pay for any injury or damage caused by our activities?
3. May firms condition EPA's entry upon signing such agreements?

ANSWERS

1. Generally, yes; employees waive their right to damages and the government is prevented from exercising its right of subrogation under the Federal Employees' Compensation Act.
2. No; Federal tort liability is established and limited by the Federal

Tort Claims Act, and such agreements are also invalid as violative of the Anti-Deficiency Act.

3. No; EPA employees possess a right of entry under both the Clean Air Act and the Federal Water Pollution Control Act Amendments of 1972.

DISCUSSION

Although the precise effect of an advance release of liability for negligence cannot be determined without reference to the law of the state in which the tort occurs, we must assume that such agreements are generally valid. By signing such agreements EPA employees may effectively waive their right to sue for damages and the government's right of subrogation under the Federal Employees' Compensation Act, 5 U.S.C. 8101 et seq.

The Restatement of Contracts, Ch. 18 §575 states:

(1) A bargain for exemption from liability for the consequences of a willful breach of duty is illegal, and a bargain for exemption from liability for the consequences of negligence is illegal if

(a) the parties are employer and employee and the bargain relates to

negligent injury of the employee in the course of the employment, or,

(b) one of the parties is charged with a duty of public service, and the bargain relates to negligence in the performance of any part of its duty to the public, for which it has received or been promised compensation...

With the exceptions mentioned in the Restatement of Contracts, *supra*, no general public policy seems to exist against express agreements for assumption of risk, and they need not be supported by consideration. 10 Prosser on Torts §55 and Restatement of Torts 2d, Ch. 17A, §496B. Despite this general rule, cases arising under the Federal Tort Claims Act involving releases signed by civilian passengers prior to boarding ill-fated government aircraft indicate that the courts do not favor such agreements. (*Friedman v. Lockheed Aircraft Corp.*, 138 F. Supp. 530 (1956) - a release is no defense against gross, willful, or wanton negligence in New York; *Rogow v. U.S.*, 173 F. Supp. 547 (1959) a release is ineffective unless the flight is gratuitous; *Montellier v. U.S.*, 315 F.2d 180 (1963) - a release does not destroy a cause of action for wrongful death in Massachusetts). Such apparent judicial disfavor of advance releases is, of course, insufficient justification for assuming the risk of signing them, and ordinary prudence requires us to assume their validity. Although signing a release does not affect the employee's right to benefits under FECA, such compensation will ordinarily be much less than might be

recovered in a tort action against the negligent corporation.

*2 Since the Federal Employees' Compensation Act, 5 U.S.C. 8131 and 8132, provides that an employee may be required to assign his right to sue third parties to the United States and that the employee must, within limitations,

pay over any recovery from third parties as reimbursement of FECA benefits, the employee's release prejudices the government's rights as well as his own. Employees should therefore be instructed not to sign such releases under any circumstances.

Although an EPA employee's express assumption of the risk of injury to himself may be valid, and agreement which purports to obligate EPA to pay all damages caused by our activities is not. The Federal Tort Claims Act, 28 U.S.C. 2674 provides:

The United States shall be liable, respecting the provisions of this title relating to tort claims, in the same manner and to the same extent as a private individual under like circumstances, but shall not be liable for interest prior to judgment or for punitive damages...

Congress has granted only a limited waiver of the government's sovereign immunity, and 28 U.S.C. 2680 lists exceptions to the general waiver stated in 28 U.S.C. 2674, supra. Exceptions which might be relevant in cases arising out of the actions of EPA employees include 28 U.S.C. 2680(a):

Any claim based upon an act or omission of an employee of the Government, exercising due care, in the execution of a statute or regulation, whether or not such statute or regulation be valid, or based upon the exercise or performance or the failure to exercise or perform a discretionary function or duty on the part of a Federal agency or an employee of the Government, whether or not the discretion involved be abused; and 28 U.S.C. 2680(b):

Any claim arising out of assault, battery, false imprisonment, false arrest, malicious prosecution, abuse of process, libel, slander, misrepresentation, deceit, or interference with contract rights ...

Since the government's tort liability is limited by statute, an administrative undertaking to expand such liability by contract is probably invalid. In any event, EPA should not create the occasion for judicial resolution of the question.

An additional basis for considering such indemnification agreements invalid is the Anti-Deficiency Act, which provides at 31 U.S.C. 665 (a):

No officer or employee of the United States shall make or authorize an expenditure from or create or authorize an obligation under any appropriation or fund in excess of the amount available therein ...

Since the extent of the government's obligation is uncertain, the Comptroller General has stated that a contractual assumption of tort liability is not a lawful obligation of the United States, and payment may not be made pursuant to

such agreement. (7 CG 507, 15 CG 803, and 35 CG 86). In fairness to companies which may rely upon the validity of such indemnity provisions, employees should be instructed not to sign them.

Inasmuch as the Clean Air Act and the Federal Water Pollution Control Act Amendments of 1972 grant EPA employees a right of entry to corporate

facilities, a company may not lawfully condition the exercise of this right upon the signing of a release or indemnity agreement. The Clean Air Act provides, at 42 U.S.C. 1857c - 9(a)(2):

*3 ... the Administrator or his authorized representative, upon presentation of his credentials - (A) shall have a right of entry to, upon, or through any premises in which an emission source is located or in which any records required to be maintained under paragraph (1) of this section are located...

The procedure for enforcement of this right is provided in 42 U.S.C. 1857c - 8:

(a)(3) Whenever, on the basis of any information available to him, the Administrator finds that any person is in violation of ... any requirement of Section 1857c - 9 of this title, he may issue an order requiring such person to comply with such section or requirement, or he may bring a civil action in accordance with subsection (b) of this section. (b) The Administrator may commence a civil action for appropriate relief, including

a permanent or temporary injunction, whenever any person - (4) fails or refuses to comply with any requirement of Section 1857c - 9 of this title.

When a firm refuses entry to an EPA employee performing his functions under the Clean Air Act, the employee may appropriately cite the statute and remind the company of EPA's right to seek judicial enforcement. If the company persists in its refusal, EPA should go to court in preference to signing a "Visitor's Release".

In addition to procedure for judicial enforcement similar to that of the Clean Air Act, the Federal Water Pollution Control Act Amendments of 1972 reinforce EPA's right of entry with criminal and civil penalties. Section 309 states:

(c)(1) Any person who willfully or negligently violates Section... 308 of this Act (Note - Section 308 establishes the right of entry) ... shall be punished by a fine of not less than \$2,500 nor more than \$25,000 per day of violation, or by imprisonment for not more than one year, or by both. If the conviction is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than \$50,000 per day of violation, or by imprisonment for not more than two years, or by both. (3) For the purposes of this subsection, the term 'person' shall mean, in addition to the definition contained in Section 502(5) of this Act, any responsible corporate officer. (d) Any person who violates Section ...

308 of this Act ... and any person who violates any order issued by the Administrator under subsection (a) of this section (Note - subsection (a) provides for administrative orders to enforce the right of entry), shall be subject to a civil penalty not to exceed \$10,000 per day of such violation. In *See v. Seattle*, 387 U.S. 541 (1967) the Supreme Court reversed the conviction of a corporation for refusal to admit building inspectors of the

City of Seattle. Justice White held that the Fourth and Fourteenth Amendments required a warrant for such inspections, even where the search was reasonably related to protecting the public health and safety and even where a corporation, rather than an individual, was the subject. Under See evidence obtained by inspectors of the Food and Drug Administration has been held inadmissible where the inspectors obtained consent to enter by threatening prosecution under 21 U.S.C. 331, which provides criminal penalties for refusal to permit entry, U.S. v. Kramer Grocery Co., 418 F2d 987 (8th Cir., 1969). Although two more recent Supreme Court decisions, Colonnade Catering Corp. v. U.S., 397 U.S. 72 (1970) and U.S. v. Biswell, 92 S. Ct. 1593 (1972), may create doubt as to whether See retains its original vigor (see Memorandum of the Assistant to the Deputy General Counsel, September 29, 1972), the possibility that evidence obtained under the FWPCA Amendments of 1972 will be ruled inadmissible is a risk EPA need not assume.

*4 Since the Amendments provide for judicial enforcement of the right of

entry, EPA employees should be instructed not to mention the civil or criminal penalties of Section 309 when faced with a refusal to permit entry. When such refusals occur, this office should be informed immediately so that a decision can be made as to whether to issue an order of the Administrator under 309(a) or seek an appropriate judicial remedy under 309(b).

FNal. Note: Marshall v. Barlow's, Inc. 98 S. Ct. 1816 (1978) affects the cases cited herein. A search warrant is required for such administrative inspections. There is an OGC memo dated June, 1978, discussing the effect of Barlow's. 1972 WL 21383 (E.P.A.G.C.)
END OF DOCUMENT

CONSENT FOR ACCESS TO PROPERTY
530 N. Lakeshore Drive

Name:

Address of Property: 530 N. Lakeshore Drive
Chicago, Illinois

I consent to officers, employees, contractors, and authorized representatives of the United States Environmental Protection Agency (U.S. EPA) entering and having continued access to this property to conduct a walkover radiological survey and sampling and investigatory activity on the property.

U.S. EPA has stated that these actions are undertaken pursuant to its response and enforcement responsibilities under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9601-9675 (1997).

This written permission is given by me voluntarily, on behalf of myself and all other co-owners of this property, with knowledge of my right to refuse and without threats or promises of any kind.

Date

Property Owner (Name and Title)

CONSENT FOR ACCESS TO PROPERTY
600 N. Lakeshore Drive

Name:

Address of Property: 600 N. Lakeshore Drive
Chicago, Illinois

I consent to officers, employees, contractors, and authorized representatives of the United States Environmental Protection Agency (U.S. EPA) entering and having continued access to this property to conduct a walkover radiological survey and sampling and investigatory activity on the property.

U.S. EPA has stated that these actions are undertaken pursuant to its response and enforcement responsibilities under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9601-9675 (1997).

This written permission is given by me voluntarily, on behalf of myself and all other co-owners of this property, with knowledge of my right to refuse and without threats or promises of any kind.

Date

Property Owner (Name and Title)



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

June 28, 2000

HSE-5J

VIA FAX AND U.S. MAIL

Mr. William A. Alter
The Alter Group
7303 N. Cicero Avenue
Lincolnwood, IL 60712

Re: Walkover Survey of Vacant Lot 4XX Ohio Street

Dear Mr. Alter:

On Wednesday, June 21, 2000, Mary Fulghum, Associate Regional Counsel, U.S. Environmental Protection Agency, telephoned you and explained that U.S. EPA is seeking access your vacant lot located in the 400 block of Ohio Street in downtown Chicago. Ms. Fulghum explained that as part of its investigation of the disposal of radioactive material from the Lindsay Light and Chemical Company (Lindsay Light) thorium mantle manufacturing plant at 316 E. Illinois, U.S. EPA was conducting radiological surveys of certain properties in the area. During your conversation with Ms. Fulghum, you indicated your willingness to authorize U.S. EPA to conduct a radiation walkover survey of the vacant lot property located at the 400 block of Ohio Street which is fenced, gated and locked. We anticipate that a walkover survey would take no more than four to six hours. Enclosed with this letter is a form allowing U.S. EPA access to conduct a walkover radiation survey of the vacant lot.

As you may have learned from recent newspaper articles or from one of U.S. EPA's Lindsay Light Fact Sheets, from 1915 until approximately 1932, Lindsay Light refined thorium containing ores and manufactured incandescent mantles for residential and commercial building lights at 316 E. Illinois. The gas mantle manufacturing involved dipping gauze mantle bags into solutions containing radioactive thorium. This former manufacturing site that is bounded by Columbus, Grand, McClurg Court, and Illinois is known as the Lindsay Light II site. (It is called Lindsay Light II because the original facility and main offices were located at 161 East Grand.) Presently, Kerr-McGee Chemical L.L.C., River East L.L.C. and Grand Pier L.L.C. are completing a removal actions at the Lindsay Light II site pursuant to an U.S. EPA administrative order issued under the Comprehensive Environmental Response Compensation and Liability Act ("CERCLA" or more commonly known as "Superfund").

U.S. EPA believes it is possible that radioactive materials from the Lindsay Light operations or demolition may have been placed onto your property. Asphalt and concrete effectively shield the gamma radiation from this material but once the asphalt and concrete is removed during development activities there may be a potential threat to human health and the environment. During your phone conversation with Mary Fulghum, you mentioned that an environmental assessment of the vacant lot property recently was conducted. It would be very helpful to U.S. EPA if you could provide a copy of that environmental assessment, whether or not it includes a radiological assessment, because it will add to our understanding of the area. Also, any geotechnical boring information would also be helpful to our investigation.

The enclosed consent for access provides U.S. EPA and its representatives access to your property to conduct radiation surveillance and sampling. Please sign this consent for access and return it to us as soon as possible. Note that this consent is for access for a radiation walk over and sampling purposes only. If access is required for other purposes, a broader access agreement will be necessary. Also, because the property is gated and locked, we will need to coordinate with the Alter Group to open the gate to allow us access and lock it after we have finished.

Please contact either myself at (312) 886-5123 or Verneta Simon, On-Scene Coordinator at (312) 886-3601, if there is additional information we can provide to you. Please direct legal matters to Mary Fulghum, Associate Regional Counsel, at (312) 886-4683. Thank you for your continued cooperation.

Sincerely,



Fredrick A. Micke, P.E.
On-Scene Coordinator
EEB Section #3

Enclosure

CONSENT FOR ACCESS TO PROPERTY

Name: William A. Alter, President
The Alter Group
7303 North Cicero Avenue
Lincolnwood, Illinois 60712

Address of Property: Vacant Lot
4XX Block Ohio Street
Chicago, Illinois

I consent to officers, employees, contractors, and authorized representatives of the United States Environmental Protection Agency (U.S. EPA) entering and having continued access to this property to conduct a walkover radiation survey and sampling on the property.

I realize that these actions taken by U.S. EPA are undertaken pursuant to its response and enforcement responsibilities under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9601-9675 (1997).

This written permission is given by me voluntarily, on behalf of myself and all other co-owners of this property, with knowledge of my right to refuse and without threats or promises of any kind.

Date

William A. Alter, President

CONSENT FOR ACCESS TO PROPERTY

Name: _____
Title: _____
Address: _____

Telephone: _____

Address of Property: 4XX East Ohio Street
Chicago, Illinois

I consent to officers, employees, contractors, and authorized representatives of the United States Environmental Protection Agency (U.S. EPA) entering and having continued access to this property to conduct a walkover radiation survey and sampling on the property.

I realize that these actions taken by U.S. EPA are undertaken pursuant to its response and enforcement responsibilities under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9601-9675 (1997).

This written permission is given by me voluntarily, on behalf of myself and all other co-owners of this property, with knowledge of my right to refuse and without threats or promises of any kind.

Date

Signature